Forest Insect & Disease Leaflet 111

Bronze Birch Borer

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The bronze birch borer (figure 1), *Agrilus anxius* Gory (Coleoptera: Buprestidae), is native to North America. Records from the late 1800's and early 1900's describe widespread damage to ornamental birches, especially in the northeastern United States and Canada. In the 1920's and 1930's, the bronze birch borer was widely reported to be associated with dying birch trees in forests and woodlands. Today, this borer often contributes to mortality of woodland birch during severe drought or other stress. It is also an important pest of landscape birches (figure 2).

The bronze birch borer occurs throughout the range of birches in Canada from Newfoundland to British Columbia, but is most common in the southern portion of the provinces. In the United States, it is distributed from Maine, across the Great Lakes region to the Cascade Mountains of Oregon and Washington, and from Maryland to Utah.

Figure 1. *Bronze birch borer adult and two D-shaped exit holes.*

Hosts

Bronze birch borers are known to attack all native and introduced birch species, although birch susceptibility varies. Many varieties of birch species as well as numerous crosses between species are currently planted as ornamentals in North America. Although some varieties are more resistant than others, none are immune to birch borer attack. Generally, the white-barked birches are more susceptible than those without white bark such as river birch, sweet birch and yellow birch. Within the white-barked birches — paper birch and gray birch — show more resistance than do many of the introduced species. Native birch species and a few of

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the more common non-native species can be grouped as follows:

Severely attacked

European white birch, *Betula pendula*
Whitebarked Himalayan birch, *Betula jacquemontii*

Commonly attacked

Paper birch, *Betula papyrifera*
Gray birch, *Betula populifolia*
Sweet birch, *Betula lenta*
Yellow birch, *Betula alleghaniensis*

Rarely attacked

River birch, *Betula nigra*

Damage Caused

Larvae damage trees by feeding on the phloem (the inner bark) and the cambium (the growth layer producing both phloem and xylem). Repeated attacks and the construction of numerous galleries by larvae eventually disrupts nutrient transport, killing roots. The damaged root system of an infested tree can't supply leaves with adequate water and branches die, further reducing the ability of the tree to produce food and transport nutrients. Most often, the end result is a dead tree.

Tree Condition

The condition of host trees is the principal factor in the birch tree and borer relationship. Adult bronze birch borers primarily attack birches that are weakened or stressed by drought, old age, insect defoliation, soil compaction, or a stem or root injury. Birch trees prefer cool, moist growing locations and have a shallow root system that is easily injured by disturbance or dry, hot conditions. Many landscape birch trees are planted in unsuitable habitats and are stressed on a regular basis. Birch trees growing within a forest are stressed by old age, weather events such as drought, or by repeated defoliation. Widespread birch mortality often occurs after these events.

Figure 2. *A landscape birch tree infested with bronze birch borers. Branches in the upper canopy are usually affected first.*

Vigorous trees can be attacked, but larvae rarely succeed in completing development. A healthy tree will produce callus tissue around the feeding gallery of a larval birch borer. If the callus can be produced quickly, the larva will be overtaken and die. If the tree is stressed, however, callus production will be too slow to prevent the larva from expanding its gallery and completing its development. Callus tissue often appears as swollen bumps or ridges under the bark on the branches or main stem (figure 3). Repeated attacks, even if unsuccessful, result in localized areas of damage that can weaken even vigorous trees over time. Many fast-growing landscape trees eventually succumb to damage from numerous unsuccessful attacks.

Birch trees that have died, broken in wind storms, or been cut or mechanically girdled may be unsuitable for larval development once the cambial tissues turn brown. Many developing larvae die in trees when the inner bark tissue dies.

Figure 3. *Swellings or bumps formed where a tree has healed over a gallery of the bronze birch borer.* Photo by D.G. Nielsen.

Evidence of Infestation

Typically, borers infest trees that have already begun to decline slightly. The first symptom is often yellow, sparse, stunted foliage in the upper crown which may progress to twig dieback and then to branch dieback (figure 4). Trees may decline for several years before dying, although they may die during a single year if conditions are hot and dry. The decline of a birch tree may be reversed in the early stages, but trees are unlikely to recover once 50 percent or more of the crown is damaged.

The bronze birch borer leaves a permanent visible record of its visit. Adult borers chew distinctive D-shaped exit holes 1/5 inch (5 mm) wide in the bark (see figure 1). These D-shaped holes may be stained with rust colored sap. Exit holes are not found on Class 1 or 2 trees and are rarely found on Class 3 and 4 trees. Most exit holes will be found on Class 5 trees.

Larvae feed under the bark in meandering galleries (figure 5) or in a series of zigzag patterns that grow increasingly larger as the larvae develop. Galleries are packed tightly with frass (excrement mixed with boring dust). Callus tissue that grows over the larval feeding galleries results in ridge-like swellings or bumps on the bark of previously infested trees (see figure 3).

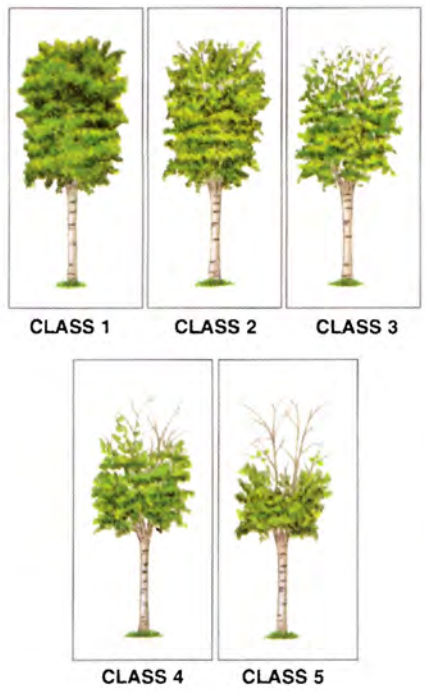

Figure 4. *Decline caused by the bronze birch borer. Class 1 trees are healthy. Class 2 trees are in the early stages of birch borer infestation. Class 3 and Class 4 trees have more advanced stages of borer infestation. Trees in Class 5 are very close to death. Trees in Classes 2 and 3 may be treated for birch borer with some success. Trees in Classes 4 and 5 are generally beyond recovery.*

Figure 5. *Meandering or zigzag galleries formed under the bark by tunneling larvae.* Photo by G. Heaton.

Life History and Developmental Stages

The life cycle of the bronze birch borer may be either 1 or 2 years long depending on host condition, geographic location, temperature, and time of emergence. In the northern portion of the borer's range, a 2-year cycle is common; in warmer regions, a 1-year cycle occurs. Development generally occurs at a faster rate in stressed or dying trees. In vigorous hosts the life cycle generally requires 2 years, or more commonly, the borer dies before completing its life cycle.

Adults emerge from previously infested trees between early May and early June in the southern part of the borer's range and from late June to mid-July further north. Adults in any one location may emerge over a 5- to 6-week period. Adult beetles live about 3 weeks. Therefore, adults may be found on trees during most of the summer.

Identification of Life Stages

Adult bronze birch borers are slender, olive-bronze beetles, with a coppery reflection (see cover photo). Males are about 1/4 to 3/8 inch (6-9 mm) long, while females are generally larger, 1/3 to 1/2 inch (8-12 mm) in length. On males, the head is greenish, while females have a copper-bronze colored head.

The egg is oval in outline and flattened, about 1/20 inch (1.5 mm) long by 1/25 inch (1 mm) wide. Eggs are creamy white when first laid, but they yellow with age.

The larva is somewhat flattened, slender, and pearly white (figure 6). The head is light brown, and at the tip of the abdomen are two short, brown, spine-like structures. Larvae range from 1/16 inch (2 mm) to 1-1/2 inches (38 mm) at maturity.

The pupa (figure 7) resembles the adult; it is initially creamy white and then darkens as it assumes adult pigmentation.

Figure 6. *Larva of the bronze birch borer.* Photo by G. Heaton.

Figure 7. *Pupa of the bronze birch borer.* Photo by G. Heaton.

Egg laying occurs in bark crevices and cracks. A common oviposition site is the roughened, dark triangular patch at branch origins. Females lay eggs singly or in clusters. The average is about 6-7 eggs in a cluster, although as many as 14-16 eggs have been recorded. Each female can lay as many as 75 eggs during her lifetime. Females begin laying eggs about 1 week after they emerge.

Larvae begin to hatch in about 2 weeks and immediately begin to mine into the phloem and cambium. Larvae make meandering or zigzagging tunnels or galleries (see figure 5). They pass through 4 instars.

When the weather cools, the larvae stop feeding and overwinter in the galleries. Because of prolonged adult emergence and the long egg-laying period, all larval stages can be present during winter, but most will be full-grown 4th instars. In the spring, small larvae resume feeding. Full-grown larvae construct shallow cells in the xylem and pupate (figure 7). Most pupae are found in May and June.

Management Techniques

In both landscapes and forests, control strategies should revolve around practices that optimize tree health. Prevention should be the cornerstone of any management program.

Landscapes

In landscapes, strategies that improve tree health will reduce susceptibility to the borer. These strategies start with selecting suitable trees and sites for planting. Proper cultural practices include watering during dry, hot periods; mulching; avoiding wounds or injury to the tree; and promptly removing dead and dying trees to reduce local borer populations.

Species selection:

Several species of birch and numerous horticultural crosses and selections are available for planting. Many of these vary in their relative susceptibility to bronze birch borer. In general, the white-barked birches are more susceptible to attacks than those without white bark (river birch, sweet birch, and yellow birch). Of the white-barked birches, native paper birch and gray birch are more resistant than many of the exotic species such as European white birch.

Soil temperature:

Birch trees thrive in cool, moist soils. Plant birch in locations where the soil will be cool and moist such as on the north or east side of buildings. However, birch trees do require some full to partial sunshine on their leaves to grow well so do not plant them under dense shade. Mulching and regular watering as described below can help maintain cool soil temperatures.

Mulch:

Mulching landscape birch trees will moderate soil temperature and conserve water in the soil. If the soil tends to dry out quickly or if there is an extended period of hot, dry weather, regular watering may be required. Most of the roots are in the top 18 inches (45 cm) of soil; a thorough watering will allow water to soak to a depth of at least 2-3 feet (1/2 to 1 m).

Sanitation:

To reduce the number of adult borers in a localized area, cut and destroy recently killed and heavily infested trees (Classes 4 and 5) before adults emerge in the spring. In Class 3 and 4 trees, most adults that complete development will emerge from the base of dead and dying branches. Therefore, prune dead and dying branches slightly below the point of dead wood. Pruning out these branches will not significantly reduce the number of larvae already in a tree because many of the larvae are located in the main stem.

Insecticides:

Insecticides can be applied to the surface of the tree bark to kill larvae emerging from eggs. Thoroughly drench the larger branches and trunk. This treatment will not kill larvae already under the bark, but it will help prevent new attacks.

Depending upon the insecticide, as many as three applications are generally required during the spring and summer (mid-May, mid-June, and mid-July). Contact local county extension agents for site-specific treatment dates and a list of registered insecticides.

Landscape birch management is discussed in detail in a Forest Service brochure titled, "How to grow and maintain a healthy birch tree" (Katovich et al. 1997).

Forests

Silvicultural practices that increase stand health and vigor should reduce bronze birch borer attacks. However, management practices that cause significant stand disturbance can initiate periods of birch decline and lead to increased problems with bronze birch borers. Thinning should be done with care in birch stands. Birch root systems are easily damaged and opening the stand can increase the sunlight and heat intensity on the forest floor. Further, birch should not be considered an inherently long-lived tree species, although yellow birch can be moderately long-lived. Older stands are more likely to undergo periods of decline than younger stands. Silvicultural prescriptions designed to enhance age class diversity will reduce susceptibility to birch borer over large areas.

The practice of keeping birch trees as "leave trees" during harvest activities should be discouraged. Because birch root systems are easily damaged during harvesting and opening of the stand, isolated birch trees or small groups of trees generally die quickly after harvest cuts. Further, dead birch quickly decay and their use as snag trees is questionable.

Natural Enemies:

Natural enemies are not thought to play a vital role in bronze birch borer dynamics, although they may be important in some situations. The most important predators are apparently woodpeckers. In some places they have removed more than 90 percent of the borer larvae in a single tree. Woodpeckers feed mainly on larvae during the winter and spring, foraging primarily on open-grown trees or where undergrowth is either short or sparse. When the effects of insect parasitoids on bronze birch borers were studied in New Brunswick and in Pennsylvania, larval parasitism in both locations was found to be approximately 18 percent. At least 13 parasitic species reportedly attack birch borer larvae. Egg parasitoids killed 50 percent of borer eggs in several New Brunswick sites, but only 7 percent of eggs in Pennsylvania sites.

Cultural Control:

Bronze birch borer larvae are sensitive to rapid drying of the host tissue and rarely complete development once the cambial tissues turn brown. Felled birch seldom produce adult beetles unless the trees are infested with late instar larvae or pupae. As a general rule, borers are likely to survive and emerge in trees cut after November 1. Rapid drying of cut material will further reduce adult emergence. Exposing slash and cut debris to full sunlight will enhance drying. Bark removal will kill most immature life stages but is generally not required.

Implications for Ecosystem Management

The bronze birch borer is a native insect and should be viewed as a normal component of any birch-dominated ecosystem. Since the borer is a "secondary" species (one that requires weakened host trees), high populations may indicate that the local or regional birch resource has some underlying stress. Most birch stands in the Great Lakes region originated in the 1920's and 1930's after extensive logging and fires. In the late 1980's, when these birch stands were more than 60 years old, a severe drought weakened trees throughout the region. Bronze birch borers infested and ultimately killed many of these trees (figure 8). Massive birch mortality was observed throughout the Great Lakes region in the early 1990's indicating that many of the existing birch-dominated ecosystems throughout the region were aging and more likely to be stressed by weather events. Developing a mosaic of age classes should reduce bronze birch borer impact over a large area and contribute to the stability of the birch resource within that region.

Figure 8. *Paper birch killed after a severe regional drought in northern Minnesota.*

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